QUANTUM BIT WITH A MULTI-TERMINAL JUNCTION AND LOOP WITH A PHASE SHIFT

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ABSTRACT

A solid-state quantum computing qubit includes a multi-terminal junction coupled to a superconducting loop where the superconducting loop introduces a phase shift to the superconducting order parameter. The ground state of the supercurrent in the superconducting loop and multi-terminal junction is doubly degenerate, with two supercurrent ground states having distinct magnetic moments. These quantum states of the supercurrents in the superconducting loop create qubits for quantum computing. The quantum states can be initialized by applying transport currents to the external leads. Arbitrary single qubit operations may be performed by varying the transport current and/or an externally applied magnetic field. Read-out may be performed using direct measurement of the magnetic moment of the qubit state, or alternatively, radio-frequency single electron transistor electrometers can be used as read-out devices when determining a result of the quantum computing. Further, qubits as described above can form arrays of qubits for performing controlled quantum computing calculations. In one example, an array of qubits can be utilized as a random number generator.